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ABSTRACT

Psychological factors that may underlie the consistent gender and ethnic group differences found in science achievement were studied in a sample of 557 college students (297 male and 260 female) taking the first semester of a 2-semester sequence in organic chemistry. About 70 percent were Caucasian, with 23 percent Asian and 37 percent African American and Hispanic American. When comparing the correlates of course performance by social group, the strongest correlates were found to be: (1) prior achievement and motivation for African American and Hispanic American students; (2) prior achievement and learning strategies for Asian and Caucasian students; (3) prior achievement and motivation for males; and (4) prior achievement and learning strategies for females. However, in a multivariate analysis, gender and ethnic differences in performance were washed out once prior achievement, motivation, and use of learning strategies were recognized. Availability of science programs in secondary schools, curricula that promote student motivation, and direct learning strategy instruction may be ways to address gender and ethnic gaps in science achievement. (SLD)

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Women and minorities in science:

Motivational and cognitive correlates of achievement

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Abstract

Our goal in this study was to try to "unpack" the psychological factors that may underlie the consistent gender and ethnic group differences found in science achievement. Prior achievement, motivation and use of learning strategies have been shown to be important factors to consider in science performance: how do these factors "work" for different social groups? Our sample consisted of 557 college students taking the first of a two-semester sequence in organic chemistry. When comparing the correlates of course performance by social group, we found that the strongest correlates of performance were: 1) prior achievement and motivation for African-American and Hispanic students; 2) prior achievement and learning strategies for Asian and Caucasian students; 3) prior achievement and motivation for males; and 4) prior achievement and learning strategies for females. However, in a multivariate analysis, gender and ethnic differences in performance were washed out once we accounted for prior achievement, motivation, and use of learning strategies. Our results indicate that gender and ethnic differences in performance are mediated by academic preparedness, motivation, and learning strategies. Availability of science programs in secondary schools, curricula that promote student motivation (e.g., Ames and her colleagues' TARGET program; project-based learning), and direct learning strategy instruction may be several ways to address the gender and ethnic gaps in science achievement.

Women and minorities in science:
Motivational and cognitive correlates of achievement

There is a large body of literature documenting the predominance of white males in the sciences, in terms of achievement as well as in choosing careers in science-related fields (e.g., Eccles, 1987; Kahle, 1985; National Research Council, 1991; Steinkamp & Maehr, 1983). A meta-analysis of studies of science achievement (Fleming & Malone, 1983) indicated that performance on science achievement measures was higher for males than females. Furthermore, Caucasians scored higher in science than did African-Americans and Hispanics. This pattern of results is found repeatedly in the literature (e.g., Steinkamp & Maehr, 1983; 1984).

One explanation suggested for these trends in science achievement is differences in motivation: that is, the will to select, persist, and engage in an academic task. Eccles (1984; 1987) reports that motivation for the task (subjective task value) is an important mediator of gender differences in achievement. Consistent with this finding, Haynes, Comer, and Hamilton-Lee (1988) found that motivation was the strongest predictor of achievement in their sample of African-American students, for both males and females.

Affect, and more specifically, test anxiety, has been a consistent negative correlate of achievement (Hembree, 1988; Sarason, 1980; Tobias, 1985; Wine, 1971). Anxiety has been shown to vary by social group, with females and minority students reporting greater levels of anxiety (Best & Stanford, 1983; Paynes, 1984; Willig, Harnisch, Hill, & Maehr, 1983). However, there is some evidence that the relationship between anxiety and performance may differ by social group: for example, Payne, Smith, and Payne (1983) found that anxiety was positively related to performance on standardized science achievement tests for fourth and eighth grade African-American children, while the opposite was true for Caucasian students.

Another mediator of science achievement may be differential use of learning strategies, or behavioral and cognitive processes utilized by the learner in order to influence the learner's encoding process (Weinstein & Mayer, 1986). Behavioral strategies include managing one's time and controlling one's effort and study environment to help optimize learning (Weinstein & Mayer, 1986; cf. Corno, 1989; 1993). Cognitive strategies can be characterized as "surface" processing (e.g., rote rehearsal) or "deep" processing (e.g., metacognitive self-regulatory strategies such as planning, monitoring, regulating). According to Pressley and his colleagues (e.g., Pressley, Symons, Snyder, & Cariglia-Bull, 1989), a good strategy user has a repertoire of strategies that are used to accomplish specific cognitive tasks and demands.

Inherent in the use of learning strategies is the intentionality and purposive behavior of the learner; that is, the interface of skill and will in order to achieve (Paris, Lipson, & Wixson, 1983). Recent work has shown that students' goals for learning (intrinsic goals such as challenge or mastery vs. extrinsic goals such as performance or competition) are related to cognitive engagement and to performance (Ames & Archer, 1988;

Graham & Golan, 1991; Pintrich & Garcia, 1991). Thus, appropriate cognitive and motivational factors are related to student learning and achievement (Pintrich, Cross, Kozma, & McKeachie, 1986).

Our goal in this study was to try to unpack the gender and ethnic group differences in science achievement. Motivation and use of learning strategies have been shown to be important factors to consider: how do these factors "work" with regard to the science achievement of different social groups? Furthermore, prior experience and ability have been shown to be highly predictive of achievement in science and in math (e.g., Benbow, 1992; Erickson & Farkas, 1991; Reynolds & Walberg, 1991; Steinkamp & Maehr, 1983). Accordingly, we have also included prior achievement in our analyses to help partial out individual differences in ability and prior knowledge in science.

Our specific research questions were: 1) how do women and minorities compare to men and Caucasian students in terms of prior achievement, motivation toward science and use of learning strategies?; 2) within each of the different social groups, which factors (prior achievement, motivational orientation, or use of particular learning strategies) are most closely related to performance?; and 3) in a multivariate analysis, which are most closely related to performance in science: gender, ethnicity, prior achievement, motivation, or use of particular learning strategies?

Method

Subjects

Subjects were 557 college students enrolled in the first semester of a year-long introduction to organic chemistry class at a major midwestern research university. Males (n = 297) and females (n = 260) were proportionately represented, and the sample was predominantly Caucasian (n = 392; 70.4%). The remaining students were Asian (n = 128; 23%), African-American, and Hispanic (n = 37; 6.6% total, African-American and Hispanic).

Measures

The Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, in press) was administered on the first and last class days of the Fall 1991 semester. Only students who had pretest and posttest MSLQ data were included for analyses. The MSLQ is a self-report, Likert-scaled instrument (1= not at all true of me to 7 = very true of me) designed to measure students' motivational outlook and use of learning strategies. We included four motivation and four learning strategies scales in this study: intrinsic goal orientation; extrinsic goal orientation; task value; test anxiety; rehearsal strategies; metacognitive self-regulatory strategies (planning, monitoring, and regulating); time and study environment management; and effort management.

In addition, achievement data were taken from university records and used for analyses. These included high school grade point average (4-point scale); math and verbal SAT scores (scaled 200-800); score on the university's chemistry placement exam (scaled 0-40); and final course grade (4-point scale).

Analyses

We used zero-order correlations, t-tests and ANOVAs for our bivariate analyses and hierarchical multiple regressions for our multivariate analyses. Given that our African-American (n = 23) and Hispanic (n = 14) samples were so small, we pooled these students together and compared them to Asian and Caucasian students. T-tests comparing African-American and Hispanic students showed that the only significant difference between the two ethnic groups on the variables of interest was in verbal SAT (t (28) = 2.29, p = .03), with Hispanic students scoring higher (M = 642.73) than African-American students (M = 555.26).

Results

Gender differences

T-tests on the motivation, learning strategies, and achievement measures show that males and females were significantly different on all measures except for math SAT, time 1 and time 2 intrinsic goal orientation and time 1 and time 2 task value (see Table 1). Males had lower high school GPAs, but higher verbal SAT scores and chemistry placement exam scores than females. In terms of motivation and learning

strategies, men endorsed a higher extrinsic goal orientation, whereas women reported higher levels of learning strategy use as well as greater test anxiety. Males showed a slight advantage in final course grade.

With regard to time 1 to time 2 changes in motivation and learning strategies, paired t-tests showed that males significantly decreased in intrinsic goal orientation; task value; and use of learning strategies. Males significantly increased in levels of extrinsic goal orientation. Females significantly decreased in intrinsic goal orientation; task value; and use of learning strategies.

Ethnic group differences[1]

The most marked differences between the ethnic groups were in the achievement measures. African-American and Hispanic students had lower high school GPAs, SAT scores, and had lower grades on the chemistry placement exam and in the final course grade, compared to Asian and Caucasian students. Asians were not different from Caucasian students in performance, except Asians had higher verbal SAT scores. In terms of motivation, minority (African-American, Hispanic, and Asian) students endorsed a higher extrinsic goal orientation at both time points than did Caucasian students. At time 2, minority students reported greater levels of test anxiety than did Caucasian students. The only difference between ethnic groups in terms of learning strategies was at time 1, where Asians reported significantly lower levels of metacognitive self-regulatory strategies (see Table 2).

Regarding time 1 to time 2 changes in motivation and learning strategies, paired t-tests showed that African-American and Hispanic students significantly decreased in use of rehearsal strategies. Asian students significantly decreased in task value and use of learning strategies. Caucasian students significantly decreased in intrinsic goal orientation, task value, and use of learning strategies, and significantly increased in extrinsic goal orientation.

Gender by ethnic group interactions

We found two significant gender by ethnicity interactions, both involving time 1 learning strategies. The two interactions seem to be driven by the difference between males and females in the African-American and Hispanic group. The first interaction (F (2,543) = 6.01, p = .003) involved time 1 use of metacognitive learning strategies (planning, monitoring, regulating). As we mentioned above, males reported using metacognitive learning strategies less frequently than females, and Asian students endorsed lower levels of metacognitive strategy use compared to African-American, Hispanic, and Caucasian students. However, when both gender and ethnicity were considered, Asian and Caucasian males and females looked more similar than did African-American and Hispanic males and females in terms of using planning, monitoring, and regulating strategies (see Figure 1). In fact, African-American and Hispanic females reported the highest mean level of metacognitive strategy use (M = 5.24).

The second interaction involved time 1 effort management (F (2,549) = 4.02, p = .018). As in the interaction with metacognitive strategy use, Asian and Caucasian males and females looked more similar in their use of effort management strategies (see Figure 2) than did African-American and Hispanic males and females. African-American and Hispanic females reported the highest mean level of effort management (M = 5.87).

Correlations between background variables, motivation, and learning strategies with course grade, by social group

Consistent across all social groups, prior achievement (high school GPA, SAT scores, and performance on the chemistry placement exam) was positively related to course grade. However, the magnitude of the correlations did vary by ethnicity and by gender (see Table 3).[2]

We found significant ethnic differences in the correlation between placement exam score and final course grade, and in the correlation between time 2 task value and course grade. The correlation between the

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[1] Since the cell ns were so disparate, we did check for heterogeneity of variance between cells. At the instances where the smaller n was paired with the higher standard deviation (therefore making alpha liberal), the observed probabilities of the F statistics were sufficiently low as to make all adjustments for liberal alphas still fall below the conventional .05 level.

[2] Differences in the magnitude of correlations were done by transforming Pearson rs to r primes, then computing z-statistics for tests of significance (Howell, 1987).

chemistry placement exam grade and final course grade was significantly higher for African-American and Hispanic students than for the Asian and Caucasian students. That is, although motivation and learning strategies were also related to course performance for African-American and Hispanic students, background preparation was still a critical factor in how well they did in the class. The correlation between time 2 task value and course performance was significantly lower for Asian students. In other words, course performance and task value were unrelated for the Asian sample. Asian students did well in the course (they had the highest mean course grade at 2.97) whether their task value was low or high.

The greatest number of significant gender differences were in the relationships between time 1 learning strategies and course grade. Greater use of rehearsal strategies at time 1 was more detrimental to women's course performance than to men's. More troubling are the significantly lower correlations between time 1 metacognitive strategies and resource management strategies and course grade for the female sample: metacognitive, time and study environment, and effort management strategies were not correlated to women's performance in the course. Similar to the pattern found with the Asian students and time 2 task value, the correlation between task value and performance was lower for women than for men. In other words, although women may have valued chemistry as much as men did (means were 5.43 and 5.47, respectively), women did not do as well in the course, so the correlation between task value and performance was lower for the female sample.

Regressions using background measures and time 1 MSLQ scales as predictors of final course grade

The analyses thus far have focused on bivariate relationships; our next data analytic step was to examine the multivariate, interdependent relationships between gender, ethnicity, motivation, cognition, and achievement. Using course grade as our outcome variable, we ran a series of hierarchical regressions, entering first the demographic variables (gender and ethnicity, using three dummy-coded variables: Gender 0 = male, 1 = female; AfrHisp 0 = no, 1 = yes; and Asian 0=no, 1 = yes. Using the two dummy variables for ethnicity made Caucasians the comparison group). Next we entered the prior achievement measures (high school GPA, math and verbal SATs, and chemistry placement exam score). We included time 1 motivation measures in the third equation, and time 1 learning strategies in the final equation (see Table 4).

Using the first equation, we found that the background variables accounted for very little of the variance in final course grade (R^2 = .03). Females, African-American, and Hispanic students scored significantly lower than males, Asian, and Caucasian students in final course grade. However, when prior achievement was included in the model, these demographic differences were washed out. Prior achievement accounted for an additional 18% of the variance in course performance, with high school GPA (β = .18) verbal SAT (β = .22) and chemistry placement score (β = .19) significantly related to higher course grades. Motivation at time 1 did not account for any significant additional variance in course grade. Rehearsal strategies (β = -.11) at time 1 were negatively related to course achievement, whereas effort management (β = .17) was positively related to course achievement. The final regression model, including demographic variables, prior achievement, motivation and learning strategy measures, accounted for 26% of the variance in final course grade.

Regressions using background measures and time 2 MSLQ scales as predictors of final course grade

Since there were significant changes in motivation and in the use of learning strategies from time 1 to time 2 for all the social groups, we reran the previous regressions using time 2 motivation and strategies measures. Accordingly, the second set of regressions paralleled the previous set of regressions except time 2, rather than time 1 measures of motivation and strategy use were included in the third and fourth equations (see Table 5). In contrast to the time 1 findings, motivation at time 2 played a significant factor in course achievement. Intrinsic (β = .17) and extrinsic (β = .10) goal orientation were significant positive predictors of final course grade; test anxiety (β = -.23) was a significant negative predictor of course achievement. The positive effect of extrinsic goal orientation decreased slightly when learning strategies were included in the model. Of the time 2 learning strategies, the only significant predictor of course achievement was effort management (β = .19). All told, background variables (demographic and prior achievement measures) and time 2 motivation and use of learning strategies accounted for a third of the total variation in final course grade (R^2 = .34).

Discussion

Although women and minorities have been widely reported as having lower levels of achievement in science, our results indicate that science achievement is less related to gender and ethnicity than to academic preparation, motivation, and use of learning strategies. Our bivariate analyses and the first stage our hierarchical regressions confirmed the advantage males and Caucasians had over women and minorities in science achievement (i.e., had higher course grades). In accordance with previous research, we found that women differed from men in terms of affect toward the material: in this case, we found that women were more test anxious than men. Contrary to previous research, we found no gender differences in task value or intrinsic orientation toward science, although this may be due to the fact that our sample did self-select themselves into this course. We found a similar pattern when comparing minorities to Caucasian students. Asians, African-Americans, and Hispanics were more test anxious, but did not differ from Caucasian students in intrinsic orientation or task value. Minority students were more concerned with grades and performance than Caucasian students.

However, in a multivariate analysis, gender and ethnicity were non-significant predictors of performance. Instead, better course performance was more closely related to academic preparedness, a mastery orientation, and high levels of effort. Lower levels of course achievement were related to high test anxiety and use of rote rehearsal strategies. These results are consistent with previous research on the relationship between motivation, strategy use, and performance (e.g., McKeachie and his colleagues; Pintrich and his colleagues). Our findings here suggest that academic preparedness, motivation, and use of learning strategies are important mediators of the achievement of women and minorities in science. Availability of science programs in secondary schools, curricula that promote student motivation (e.g., Ames and her colleagues' TARGET program; project-based learning, Blumenfeld, Soloway, Marx, & Krajcik, 1991), and direct learning strategy instruction may be several ways to address the gender and ethnic gaps in science achievement.

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Table 1

Gender differences in performance, motivation, and learning strategies measures

	Males (n = 297)	Females (n = 260)	t (df = 554)
Background Performance			
High school GPA (0 - 4.0)	3.68	3.74	2.25*
Math SAT (200-800)	568.10	565.22	.34
Verbal SAT (200-800)	675.66	636.01	5.03***
Chemistry placement exam (0 - 40)	26.86	23.37	5.63***
Motivation at Time 1			
Intrinsic Goal Orientation	5.20	5.23	.33
Extrinsic Goal Orientation	5.07	4.86	2.16*
Task Value	5.70	5.74	.51
Test Anxiety	3.59	4.01	3.69***
Learning Strategies at Time 1			
Rehearsal Strategies	4.34	4.94	6.08***
Metacognitive Self-Regulatory Strategies	4.58	4.84	3.83***
Time & Study Environment Management	5.19	5.60	5.11***
Effort Management	5.33	5.59	2.94**
Motivation at Time 2			
Intrinsic Goal Orientation	5.03	4.94	.98
Extrinsic Goal Orientation	5.34	4.97	3.78***
Task Value	5.47	5.43	.57
Test Anxiety	3.73	4.05	2.74**
Learning Strategies at Time 2			
Rehearsal Strategies	3.77	4.42	5.68***
Metacognitive Self-Regulatory Strategies	4.25	4.63	4.50***
Time & Study Environment Management	4.70	4.95	2.97**
Effort Management	4.92	5.19	2.85**
Class Performance			
Final course grade (0 - 4.0)	3.02	2.81	3.04**

Note: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Table 2

Ethnic group differences in performance, motivation, and learning strategies measures

	AfrAm/Hisp (n = 37)	Asian (n = 128)	White (n = 392)	F (2, 553)
Background Performance				
High school GPA (0 - 4.0)	3.50_a	3.71_b	3.72_b	8.48***
Math SAT (200-800)	506.00_a	588.02_b	565.21_b	11.69***
Verbal SAT (200-800)	587.33_a	687.17_b	654.26_c	20.63***
Chemistry placement exam (0 - 40)	19.50_a	26.51_b	25.38_b	14.09***
Motivation at Time 1				
Intrinsic Goal Orientation	5.35	5.07	5.24	2.05
Extrinsic Goal Orientation	5.41_a	5.32_a	4.82_b	12.13***
Task Value	5.75	5.66	5.74	.39
Test Anxiety	4.21	3.90	3.71	2.95
Learning Strategies at Time 1				
Rehearsal Strategies	4.91	4.55	4.62	1.27
Metacognitive Self-Reg. Strategies	4.73_{ab}	4.53_a	4.75_b	3.51*
Time & Study Env. Management	5.35	5.30	5.41	.68
Effort Management	5.39	5.35	5.49	1.04
Motivation at Time 2				
Intrinsic Goal Orientation	5.22	4.97	4.97	.84
Extrinsic Goal Orientation	5.24_{ab}	5.45_a	5.07_b	5.39**
Task Value	5.55	5.36	5.47	.55
Test Anxiety	4.52_a	4.03_{ab}	3.77_b	5.89**
Learning Strategies at Time 2				
Rehearsal Strategies	4.18	4.04	4.07	.13
Metacognitive Self-Reg. Strategies	4.48	4.23	4.48	2.97
Time & Study Environment Mgmt.	5.04	4.69	4.83	1.90
Effort Management	5.17	4.96	5.07	.67
Class Performance				
Final course grade (0 - 4.0)	2.50_a	2.97_b	2.94_b	5.26**

Note 1. Means with different subscripts are significantly different from one another at alpha = .05 (post hoc Scheffe tests).

Note 2. * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Table 3

Correlations between background variables, motivation, and learning strategies with course grade, by social group

	AfrAm/Hisp (n = 37)	Asian (n = 128)	White (n = 392)	Males (n = 297)	Females (n = 260)
Background: performance					
High school GPA	.25	.26	.23	.24	.34
Math SAT	.35	.16	.23	.20	.29
Verbal SAT	$.59_a$	$.32_b$	$.32_b$	.32	.37
Chem. placement exam	$\mathbf{.63_a}$	$\mathbf{.33_b}$	$\mathbf{.27_b}$	.32	.28
Motivation: Time 1					
Intrinsic Goal Orientation	-.10	.14	.13	.13	.08
Extrinsic Goal Orientation	-.19	-.14	-.12	-.11	-.20
Task Value	-.09	-.07	.06	$.09_a$	$-.06_b$
Test Anxiety	-.21	-.17	-.16	-.12	-.19
Strategies: Time 1					
Rehearsal	$-.36_a$	$-.05_b$	$-.11_b$	$\mathbf{-.01_a}$	$\mathbf{-.20_b}$
Metacognitive Self Reg.	-.03	.09	.19	$\mathbf{.26_a}$	$\mathbf{.06_b}$
Time & Study Env. Mgmt.	-.09	.17	.12	$\mathbf{.23_a}$	$\mathbf{.02_b}$
Effort Management	$-.08_a$	$.26_b$	$.18_b$	$\mathbf{.28_a}$	$\mathbf{.10_b}$
Motivation: Time 2					
Intrinsic Goal Orientation	.24	.24	.37	$.38_a$	$.24_b$
Extrinsic Goal Orientation	$.33_a$	$.04_b$	$.04_b$	.04	.04
Task Value	$\mathbf{.32_{ab}}$	$\mathbf{.05_a}$	$\mathbf{.35_b}$	$\mathbf{.36_a}$	$\mathbf{.19_b}$
Test Anxiety	-.10	-.35	-.26	-.32	-.22
Strategies: Time 2					
Rehearsal	-.11	-.16	-.12	-.10	-.10
Metacognitive Self Reg.	.13	.14	.16	.19	.16
Time & Study Env. Mgmt.	-.11	.22	.11	.14	.11
Effort Management	.14	.30	.29	.30	.28

Note. Correlations with different subscripts are different from one another: values in bold are significantly different at alpha ≤ .05, others are different at alpha ≤ .15.

Table 4

Hierarchical regression results, with final course grade as the outcome variable and background and time 1 motivation and learning strategies as predictors

	Equation 1	Equation 2	Equation 3	Equation 4
Background: demographic				
Gender (0 = Male; 1 = Female)	-.12*	.05	-.05	-.07
AfrHisp (1 = African-American or Hispanic)	-.13*	.01	.01	.01
Asian (1 = Asian)	.02	-.04	-.02	-.02
Background: performance				
High school GPA		.18***	.18***	.15**
Math SAT		.06	.06	.05
Verbal SAT		.22***	.21***	.24***
Chem. placement exam		.19***	.17**	.15**
Motivation: Time 1				
Intrinsic Goal Orientation			.08	.02
Extrinsic Goal Orientation			-.06	-.07
Task Value			-.06	-.10
Test Anxiety			-.04	.02
Learning Strategies: Time 1				
Rehearsal				-.11*
Metacognitive Self-Regulatory Strategies				.05
Time & Study Environment Management				.04
Effort Management				.17*
R^2	.03**	.21***	.22***	.26***
Change in R^2		.18***	.01	.04**

Note 1. Standardized regression coefficients reported, pairwise deletion of missing data.

Note 2. + $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Table 5

Hierarchical regression results, with final course grade as the outcome variable and background and time 2 motivation and learning strategies as predictors

	Equation 1	Equation 2	Equation 3	Equation 4
Background: demographic				
Gender (0 = Male; 1 = Female)	-.12*	.05	-.01	-.02
AfrHisp (1 = African-American or Hispanic)	-.13*	.01	.00	-.02
Asian (1 = Asian)	.02	-.04	-.03	-.03
Background: performance				
High school GPA		.18***	.13**	.12*
Math SAT		.06	.06	.06
Verbal SAT		.22***	.20***	.21***
Chem. placement exam		.19***	.12*	.11*
Motivation: Time 2				
Intrinsic Goal Orientation			.17**	.15*
Extrinsic Goal Orientation			.10*	.09+
Task Value			.09	.06
Test Anxiety			-.23***	-.17***
Learning Strategies: Time 2				
Rehearsal				-.09
Metacognitive Self-Regulatory Strategies				-.04
Time & Study Environment Management				.01
Effort Management				.19**
R^2	.03**	.21***	.31***	.34***
Change in R^2		.18***	.10***	.03**

Note 1. Standardized regression coefficients reported, pairwise deletion of missing data.

Note 2. + $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Figure 1. Time 1 metacognitive learning strategies, gender by ethnic group interaction.

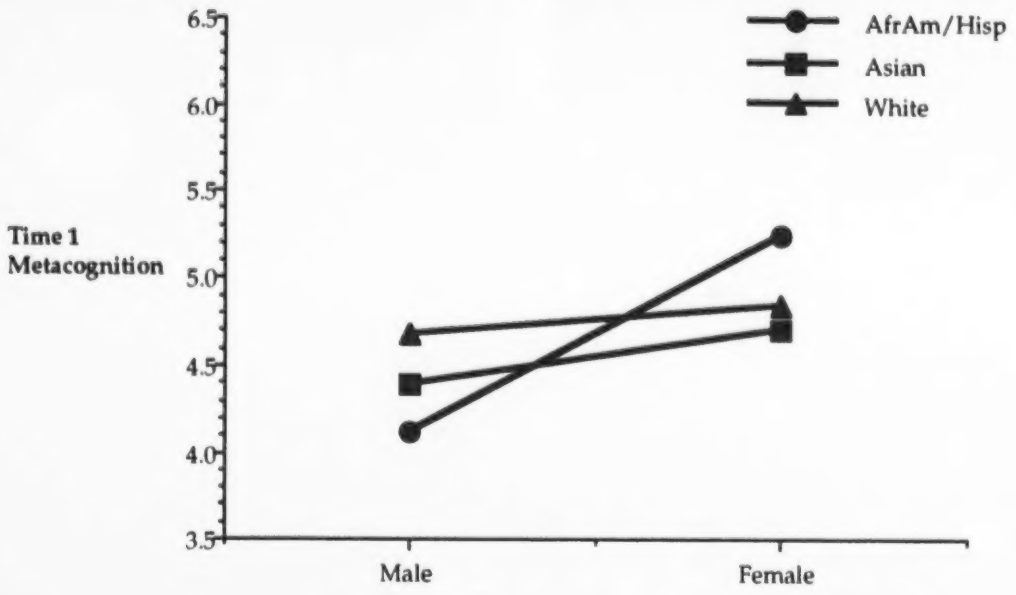

Figure 2. Time 1 effort management strategies, gender by ethnic group interaction.